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(54) **REFRIGERATION SYSTEM WITH DIRECT EXPANSION REFRIGERATION MODE AND REFRIGERANT PUMPING ENERGY-EFFICIENCY MODE AND CONTROL METHOD OF REFRIGERATION SYSTEM**

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F25B 25/00 (2006.01)
F25B 41/40 (2021.01)

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See application file for complete search history.

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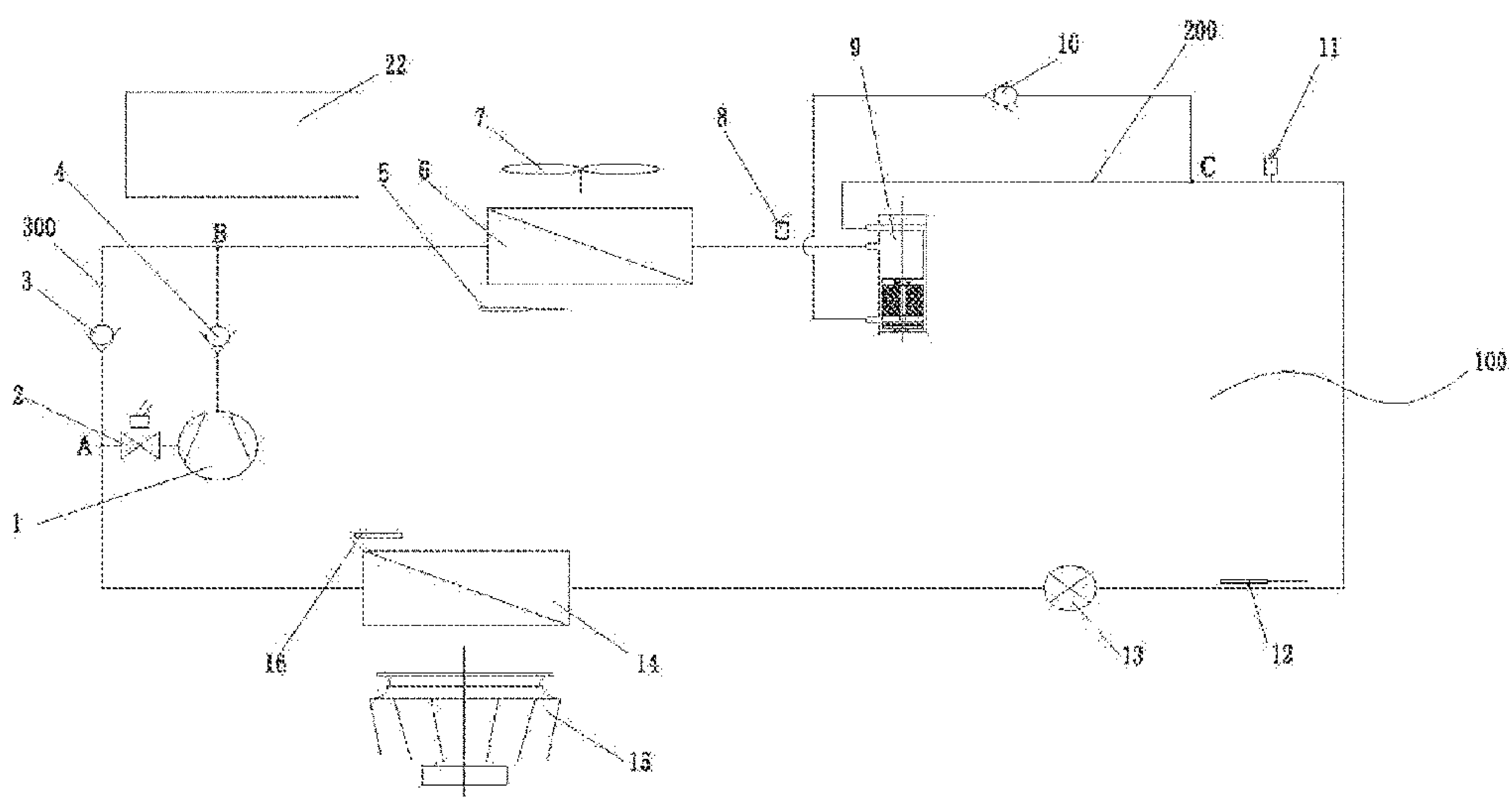
(57) **ABSTRACT**

A refrigeration system and a control method of the refrigeration system are provided. The refrigeration system includes a cooling circuit and a compressor, an evaporator assembly, and a condenser assembly sequentially arranged on the cooling circuit, and the refrigeration system further includes: a liquid pump cooling assembly, arranged on the cooling circuit and located between the condenser assembly and the evaporator assembly, the liquid pump cooling assembly includes a housing and a liquid pump arranged in the housing, the housing defines a cavity having a liquid reserving function, a refrigerant inlet, a first outlet connected to the cavity and a second outlet connected to the liquid pump, an outlet of the condenser assembly is in connected with the refrigerant inlet, and both the first and second outlets are connected with an inlet of the evaporator assembly; a control assembly, connected with the compressor and the liquid pump.

19 Claims, 4 Drawing Sheets



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CPC *F25B 2700/2104* (2013.01); *F25B 2700/2106* (2013.01); *F25B 2700/2117* (2013.01)

Fig. 1

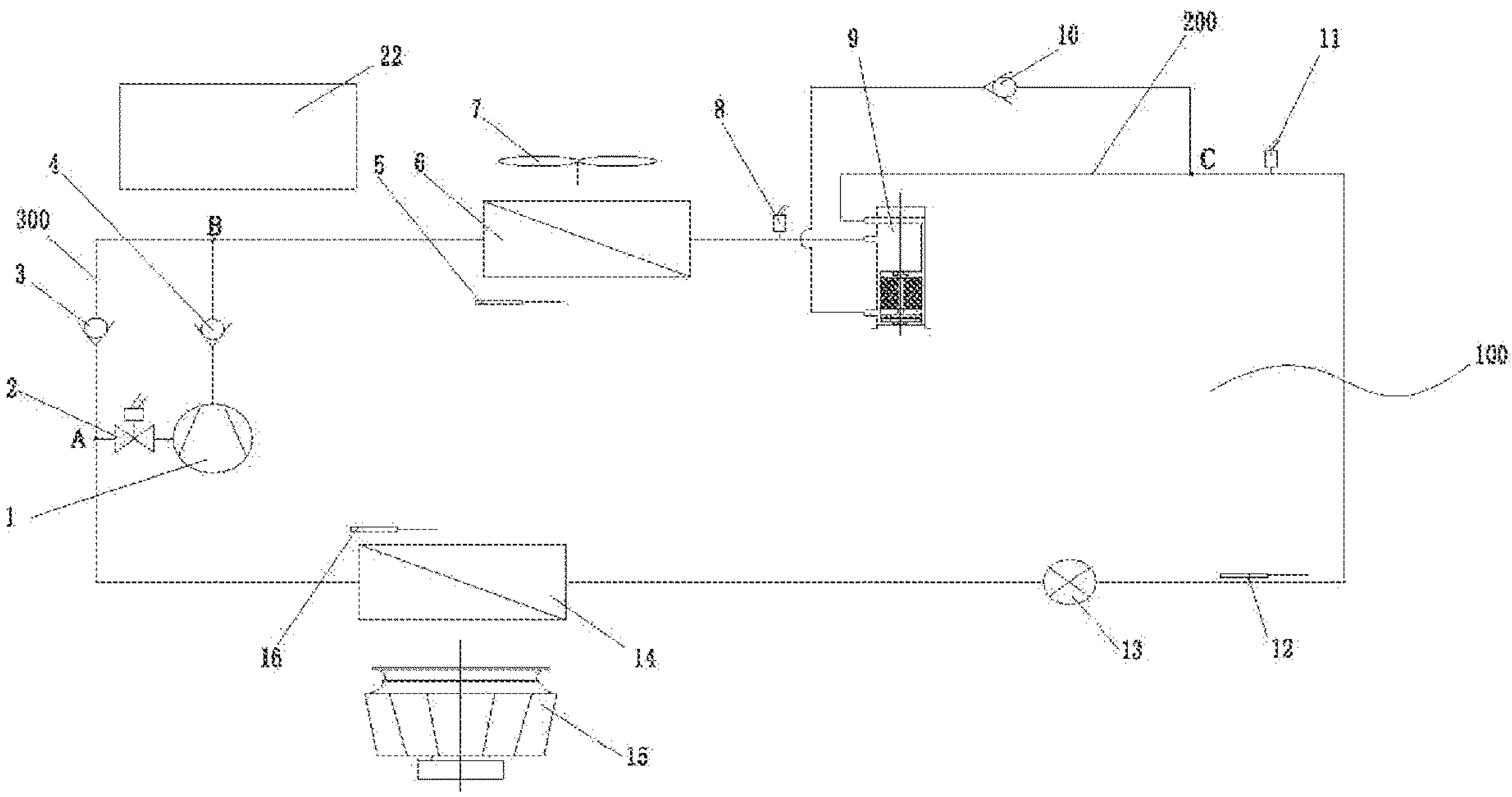


Fig. 2

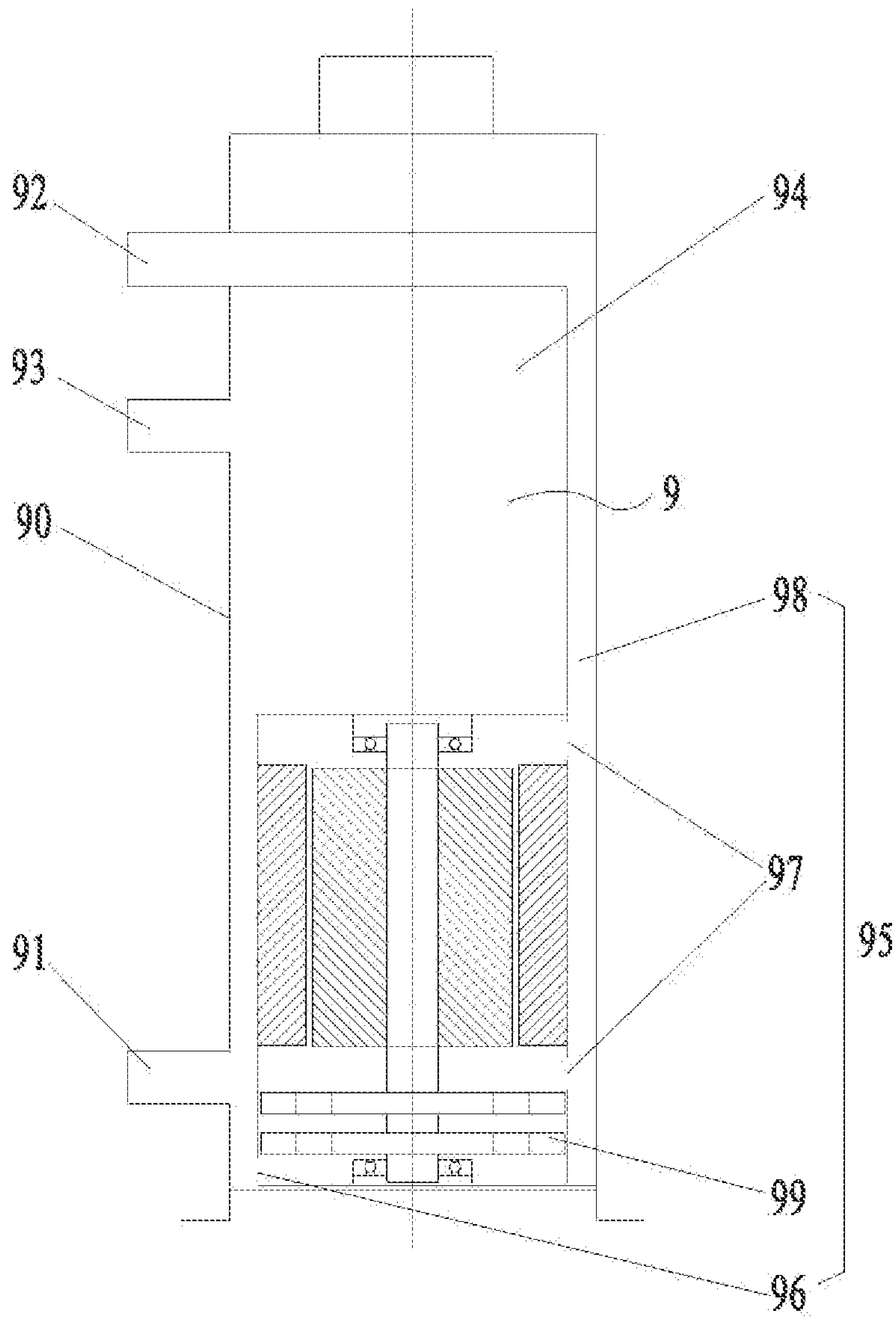


Fig. 3

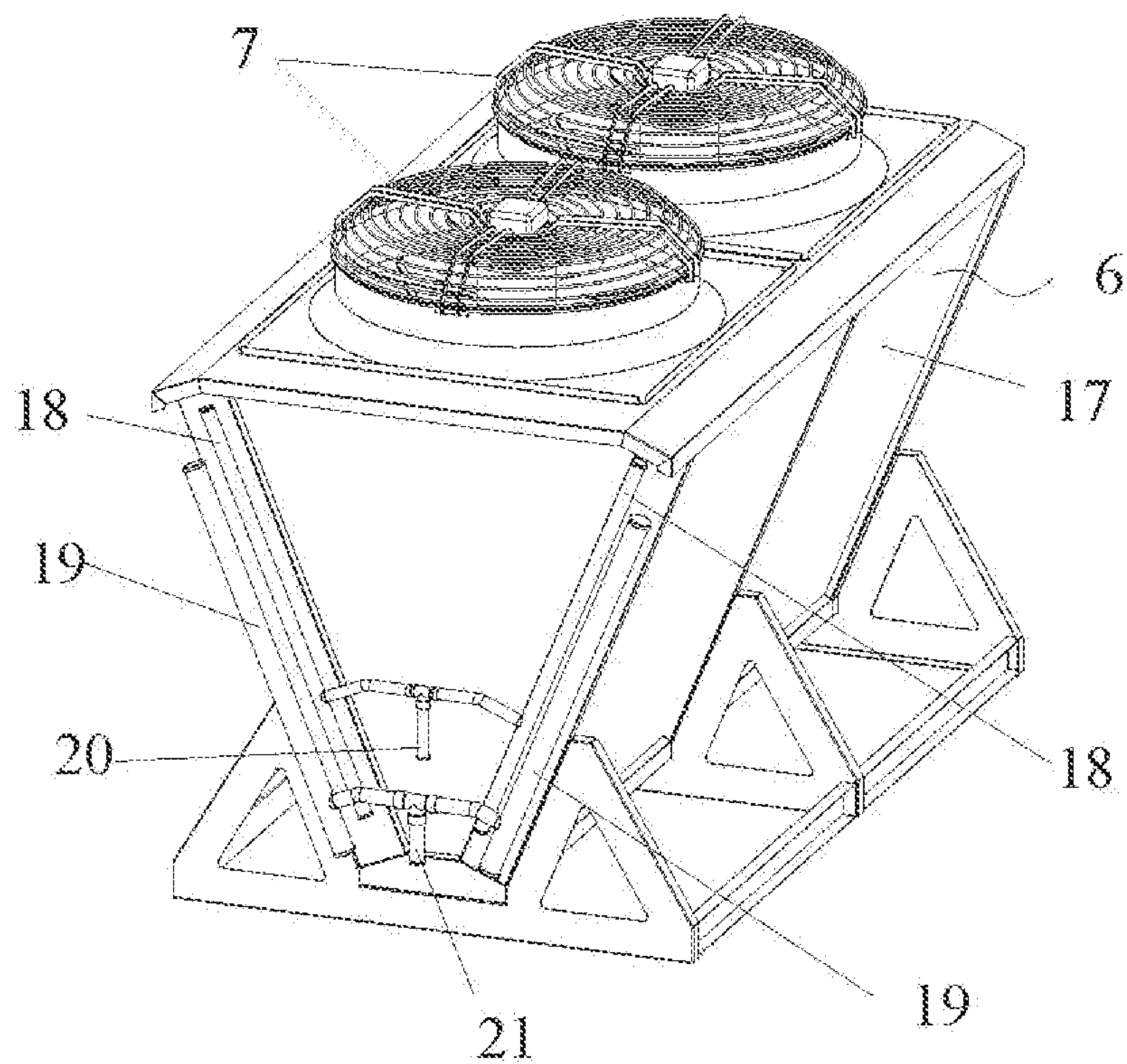
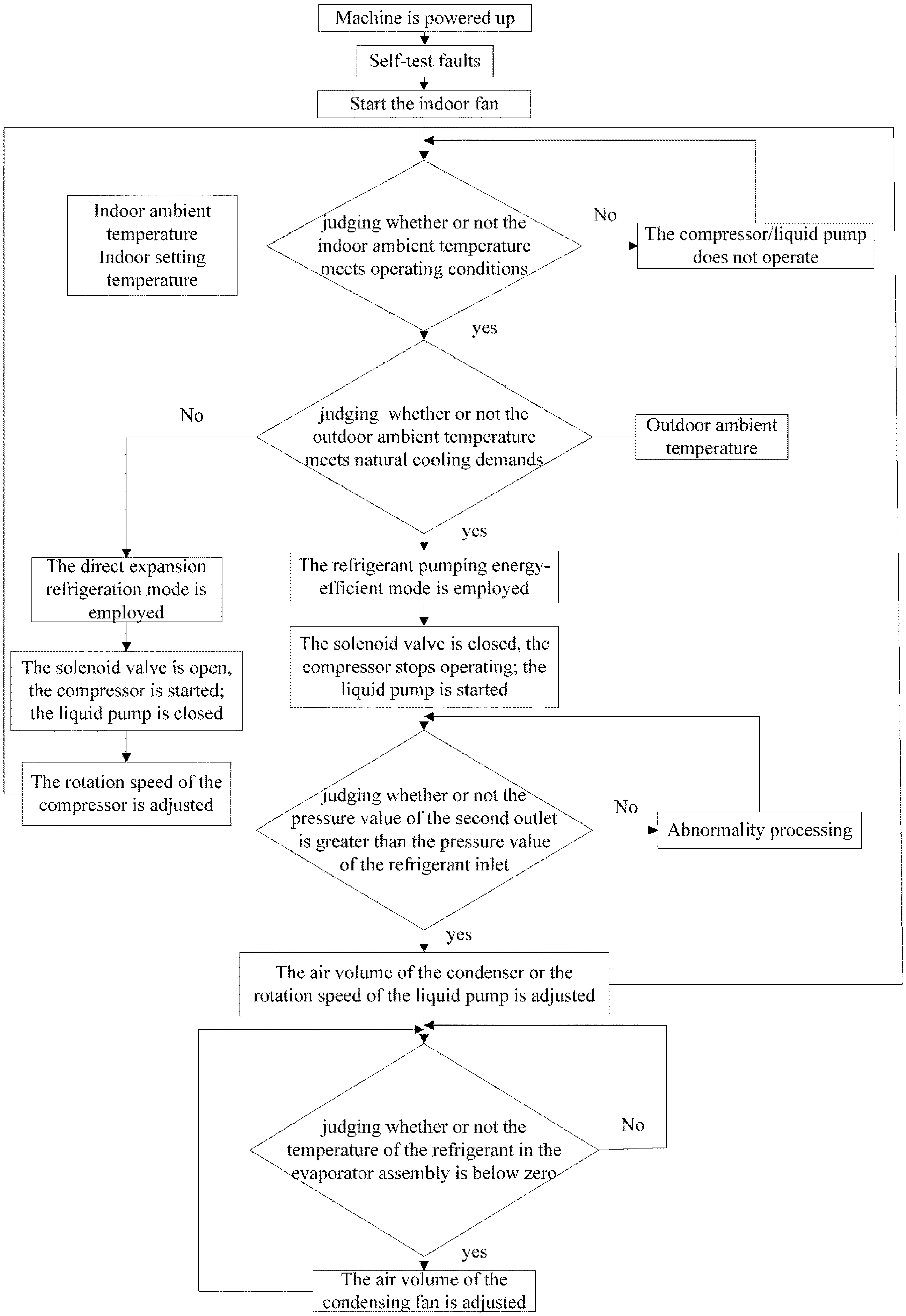


Fig. 4

The refrigeration system is controlled to be in a refrigerant pumping energy-efficient mode

The refrigeration system is controlled to be in a direct expansion refrigeration mode

Fig. 5


Machine is powered up
Self-test faults
Start the indoor fan
Indoor ambient temperature
Indoor setting temperature
judging whether or not the indoor ambient temperature meets operating conditions
No
The compressor/liquid pump does not operate
yes
No
judging whether or not the outdoor ambient temperature meets natural cooling demands
Outdoor ambient temperature
yes
The direct expansion refrigeration mode is employed
The refrigerant pumping energy-efficient mode is employed
The solenoid valve is open, the compressor is started; the liquid pump is closed
The solenoid valve is closed, the compressor stops operating; the liquid pump is started
The rotation speed of the compressor is adjusted
judging whether or not the pressure value of the second outlet is greater than the pressure value of the refrigerant inlet
No
Abnormality processing
yes
The air volume of the condenser or the rotation speed of the liquid pump is adjusted
judging whether or not the temperature of the refrigerant in the evaporator assembly is below zero
No
yes
The air volume of the condensing fan is adjusted

REFRIGERATION SYSTEM WITH DIRECT EXPANSION REFRIGERATION MODE AND REFRIGERANT PUMPING ENERGY-EFFICIENCY MODE AND CONTROL METHOD OF REFRIGERATION SYSTEM

CROSS-REFERENCE TO RELATED APPLICATION(S)

The present disclosure claims priority to patent application No. 202111370440.2, presented and filed in the China National Intellectual Property Administration on Nov. 18, 2021, entitled "Refrigeration System and Control Method of Refrigeration System".

TECHNICAL FIELD

The disclosure relates to the field of air conditioning refrigeration, and particularly, to a refrigeration system and a control method of the refrigeration system.

BACKGROUND

At present, in the field of air conditioning refrigeration, a compressor refrigeration cycle and a fluorine pump refrigeration cycle are two refrigeration systems that are usually employed, the amounts of refrigerants used for the two refrigeration cycles are different, therefore to balance the amounts of refrigerants used for the two, a reservoir for temporarily reserving excess refrigerants in a cycle circuit is usually added between a fluorine pump and an outdoor unit. However, in this way, the amount of refrigerants used in the systems will be increased and the cost of the systems will also be increased, and when the system leaks, there would be a significant impact on the environment; furthermore, due to the need to store a large amount of excess refrigerants, the reservoir needs to able to hold a large volume of refrigerant, resulting in an increase in the volume of the entire refrigeration system.

SUMMARY

Some embodiments of the present disclosure provide a refrigeration system and the control method of the refrigeration system. Reduce the volume of the refrigeration system and the energy consumption.

To achieve the above-mentioned objective, according to the given examples of the present disclosure, a refrigeration system is provided. The refrigeration system includes a cooling circuit and a compressor, an evaporator assembly, and a condenser assembly sequentially arranged on the cooling circuit, and the refrigeration system further includes: a liquid pump cooling assembly, arranged on the cooling circuit and located between the condenser assembly and the evaporator assembly, the liquid pump cooling assembly includes a housing and a liquid pump arranged in the housing, the housing defines a cavity having a liquid reservation function, a refrigerant inlet connected with the cavity, a first outlet connects with the cavity and a second outlet connects with the liquid pump, an outlet of the condenser assembly connects with the refrigerant inlet, and both the first and second outlets are connected with an inlet of the evaporator assembly; a control assembly, the compressor and the liquid pump are connected with the control assembly respectively, enabling the refrigeration system to have a direct expansion refrigeration mode and a refrigerant pump

energy-efficiency mode; in the direct expansion refrigeration mode, the compressor is in an open state and compresses the refrigerant that is in a vapor phase, and the liquid pump is in a closed state, the refrigerant flowing out from the outlet of the condenser assembly enters into the evaporator assembly after sequentially passing through the refrigerant inlet and the first outlet so as to enable the refrigerant to circulate in the cooling circuit through the compressor; in the refrigerant pump energy-efficiency mode, the liquid pump is in an open state and pumps the refrigerant in a liquid state, and the compressor is in a closed state, under the action of the liquid pump, the refrigerant flowing out from the outlet of the condenser assembly flows out of the second outlet and enters into the evaporator assembly.

The refrigeration system further includes: a first pipeline, an end of the first pipeline being connected with the second outlet, an other end of the first pipeline is in a connection with the inlet of the evaporator assembly; a first one-way valve, arranged on the cooling circuit, and located between the refrigerant inlet, and a connecting node of the first pipeline and the cooling circuit, the first one-way valve is configured to prevent the refrigerant from flowing back to the refrigerant inlet, when the refrigeration system is in the refrigerant pump energy-efficiency mode, the refrigerant flowing out from the outlet of the condenser assembly flows into the evaporator assembly through the first pipeline.

In reference to the vertical direction, a height dimension of the first outlet is smaller than the height dimension of the second outlet, and the refrigerant inlet is located between the first and second outlets, the liquid pump is located below the cavity, and an interior chamber of the liquid pump is connected with the cavity.

The refrigeration system further includes: a second pipeline, arranged in parallel with the compressor, a first end of the second pipeline being connected with an outlet of the evaporator assembly, a second end of the second pipeline is connected with an inlet of the condenser assembly; and a second one-way valve, located on the second pipeline.

The refrigeration system further includes a solenoid valve located on the cooling circuit, wherein the solenoid valve is located between an inlet of the compressor and a connecting node of the second pipeline and the cooling circuit.

The condenser assembly includes: a condenser body having a condensing inlet and a condensing outlet; a gas header, connected with the condensing inlet, and the gas header being connected with an outlet of the compressor; a liquid header, connected with the condensing outlet, and the liquid header being connected with the refrigerant inlet; a pipe diameter of the liquid header is greater than a pipe diameter of the gas header.

The condenser body is of V-shaped, and the condenser assembly further includes a condensing fan located over the condenser body, and the condenser assembly includes a first branch pipe and a second branch pipe, the gas header is connected with the outlet of the condenser through the first branch pipe, and the liquid header is connected with the refrigerant inlet through the second branch pipe.

The refrigeration system further includes: an expansion valve, arranged between the evaporator assembly and the liquid pump cooling assembly; a first temperature sensor, along with a flow direction of the refrigerant in the cooling circuit, located at an upstream position of the expansion valve to detect a temperature of the refrigerant entering the evaporator assembly.

According to some embodiments of the present disclosure, a control method for controlling by adopting the above-mentioned refrigeration system is provided. The control method includes: an energy-efficiency refrigeration step of controlling the refrigeration system to be in a refrigerant pumping energy-efficiency mode; a compression refrigeration step of controlling the refrigeration system to be in a direct expansion refrigeration mode.

The condenser assembly includes a condenser body and a condensing fan located at a side of the condenser body. After the energy-efficiency refrigeration step, the control method further includes: determining a pressure level of the second outlet and a pressure level the refrigerant inlet; and a pressure level evaluation step of evaluating whether or not the pressure level of the second outlet of a liquid pump cooling assembly is greater than the pressure level of the refrigerant inlet, if so, the step of adjusting a rotation speed of a condensing fan or of a liquid pump is executed; if not, an abnormality processing step is executed.

After the energy-efficiency refrigeration step, the control method further includes: a detection step of detecting a temperature of the refrigerant that enters into the evaporator assembly; a temperature judgment step of judging whether or not the temperature of the refrigerant is below zero, if so, the step of adjusting a rotation speed of the condensing fan of the condenser assembly is executed; if not, the temperature judgment step is repeatedly executed.

In some embodiments, in the compression refrigeration step, the control method further includes an adjustment step of adjusting a rotation speed of a compressor.

The technical solution of the present disclosure is applied, the evaporator assembly is configured to evaporate the liquid refrigerant that flows into a gaseous refrigerant, and a low-temperature and low-pressure refrigerant gas flows out; the condenser assembly may function to dissipate heat and to condense the gaseous refrigerant into a liquid refrigerant; the compressor is configured to compress the low-pressure refrigerant gas that flows into a superheated high-pressure refrigerant gas, and the compressor can drive the refrigerant to circulate in the cooling circuit. The liquid pump cooling assembly includes the housing and the liquid pump arranged in the housing. In this way, the housing defines a cavity having a liquid reservoir function, so that the cavity and liquid pump are connected and form a complete structure, so there is no need to additionally arrange a separate reservoir. After this arrangement, the liquid pump cooling assembly is small in volume and compact in structure, and the arrangement may further reduce the refrigerant charge in the refrigeration system, so as to achieve functions of reducing energy consumption and costs; and at the same time, since the above-mentioned liquid pump cooling assembly is provided therein with one inlet and two outlets (i.e. the first outlet and the second outlet), the two outlets may send the refrigerant to different pipelines, and the refrigeration system can have the direct expansion refrigeration mode and the refrigerant pumping energy-efficiency mode, so as to achieve a function of integrating two refrigeration modes on the same cooling circuit; in addition, switching between the above-mentioned two refrigeration modes may be further achieved based on demand by the control assembly that connects to the compressor and the liquid pump.

BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings, which form a part of the present application, are used to provide a further understanding of the present disclosure, and the illustrative examples of the present disclosure and the description thereof are used for explaining the present disclosure, and do not constitute an improper limitation to the present disclosure. In the drawings:

FIG. **1** shows a schematic of the principle diagram showing the refrigeration system according to the present disclosure

FIG. **2** shows a schematic structural diagram of a liquid pump cooling assembly of FIG. **1** according to the example of the present disclosure

FIG. **3** shows a schematic structural diagram of a condenser assembly of FIG. **1** according to the example of the present disclosure;

FIG. **4** shows a flowchart of a control method of a refrigeration system according to the example of the present disclosure; and

FIG. **5** shows a detailed flowchart of a control method of a refrigeration system according to the example of the present disclosure.

The above-mentioned drawings include the following reference signs:

1. Compressor; **2**. Solenoid valve; **3**. Second one-way valve; **4**. Third one-way valve; **5**. Second temperature sensor; **6**. Condenser assembly; **7**. Condensing fan; **8**. First pressure sensor; **9**. Liquid pump cooling assembly; **10**. First one-way valve; **11**. Second pressure sensor; **12**. First temperature sensor; **13**. Expansion valve; **14**. Evaporator assembly; **15**. Indoor fan; **16**. Third Temperature sensor; **17**. Condenser body; **18**. Gas header; **19**. Liquid header; **20**. First branch pipe; **21**. Second branch pipe; **22**. Control assembly; **90**. Housing; **91**. First outlet; **92**. Second outlet; **93**. Refrigerant inlet; **94**. Cavity; **95**. Liquid pump; **96**. Inner inlet; **97**. Inner outlet; **98**. Outlet pipe; **99**. Impeller; **100**. Cooling circuit; **200**. First pipeline; **300**. Second pipeline.

DETAILED DESCRIPTION OF THE EMBODIMENTS

It is to be noted that the examples in the present application and the features in the examples may be combined with each other if there is no conflict. The present disclosure will be described in detail below with reference to the accompanying drawings and in combination with the examples.

As shown in FIG. **1**, some examples of the present disclosure present a refrigeration system. The refrigeration system includes a cooling circuit **100** and a compressor **1**, an evaporator assembly **14**, and a condenser assembly **6** sequentially arranged on the cooling circuit **100**. The compressor **1**, the evaporator assembly **14**, and the condenser assembly **6** each have an inlet and an outlet, and the refrigeration system further includes a liquid pump cooling assembly **9**, a control assembly **22**, and an indoor fan **15**. Wherein, the liquid pump cooling assembly **9** is arranged on the cooling circuit **100** and located between the condenser assembly **6** and the evaporator assembly **14**, and the liquid pump cooling assembly **9** includes a housing **90** and a liquid pump **95** arranged in the housing **90**, the housing **90** defines a cavity **94** having a liquid reserving function, a refrigerant inlet **93** communicating with the cavity **94**, a first outlet **91** communicating with the cavity **94** and a second outlet **92** communicating with the liquid pump **95**, an outlet of the condenser assembly **6** is in communication with the refrigerant inlet **93**, and both the first and second outlets **91**, **92** are in communication with an inlet of the evaporator assembly **14**; a control assembly **22** is connected with the compressor **1** and the liquid pump **95**, so as to enable the refrigeration system to have a direct expansion refrigeration mode and a refrigerant pumping energy-efficiency mode; in the direct expansion refrigeration mode, the compressor **1** is in an open state and compresses refrigerant that is in a vapor phase, and the liquid pump **95** is in a closed state, refrigerant flowing out from the outlet of the condenser assembly **6** enters into the evaporator assembly **14** after sequentially passing through the refrigerant inlet **93** and the first outlet **91**, so as to enable the refrigerant to circulate in the cooling circuit **100** by the compressor **1**; in the refrigerant pumping energy-efficiency mode, the liquid pump **95** is in an open state and pumps liquid refrigerant, and the compressor **1** is in a closed state, under an action of the liquid pump **95**, refrigerant flowing out from the outlet of the condenser assembly **6** flows out from the second outlet **92** and enters into the evaporator assembly **14**.

In the above-mentioned technical solution, in the refrigeration system, the evaporator assembly **14** is configured to evaporate liquid refrigerant that flows in into a gaseous refrigerant, and a low-temperature and low-pressure refrigerant gas flows out; the condenser assembly **6** may function to dissipate heat and to condense the gaseous refrigerant into a liquid refrigerant. When the refrigeration system is in the direct expansion refrigeration mode, the control assembly **22** controls the compressor **1** to be in an open state and the liquid pump **95** to be in a closed state, the compressor **1** is configured to compress the low-pressure refrigerant gas that flows in into a superheated high-pressure refrigerant gas, and the compressor **1** is able to drive the refrigerant to circulate in the cooling circuit **100**; the outlet of the compressor **1** is connected with the inlet of the condenser assembly **6**, so as to send the gaseous refrigerant compressed by the compressor **1** to the condenser assembly **6**.

The above-mentioned gaseous refrigerant dissipates heat in the condenser assembly **6** and is condensed into a high-pressure saturated liquid refrigerant and then flows out. The above-mentioned liquid refrigerant flows into the cavity from the refrigerant inlet **93** and directly flows out from the first inlet **91**, and then enters the evaporator assembly **14**, to achieve circulation of the refrigerant in the cooling circuit **100**.

When the refrigeration system is in the refrigerant pumping energy-efficiency mode, the control assembly **22** controls the compressor **1** to be in a closed state and the liquid pump **95** to be in an open state, a low-temperature and low-pressure liquid refrigerant can flow out from the condenser assembly **6**, the outlet of the condenser assembly **6** connects with the refrigerant inlet **93** of the liquid pump cooling assembly **9**. Under the pumping action of the liquid pump **95**, the liquid refrigerant is pumped into the evaporator assembly **14** through the second outlet **92**. In this mode, the liquid refrigerant achieves circulating in the cooling circuit by bypassing the compressor **1**. Therefore, the above-mentioned refrigeration system has the direct expansion refrigeration mode and the refrigerant pumping energy-efficiency mode.

In this way, when outdoor temperature is high, the refrigeration system cannot use the outdoor temperature to cool down indoor equipment and so opens the direct expansion refrigeration mode, at this moment the compressor **1** is in an open state and the liquid pump **95** is in a closed state; when the outdoor temperature is low and can meet natural cooling demand, the compressor **1** is in the closed state, and the liquid pump **95** is in the open state, the refrigerant may make full use of outdoor natural resources to cool down the indoor equipment without passing through the compressor **1**, so as to achieve functions of reducing energy consumption and costs.

In some examples of the present disclosure, the liquid pump cooling assembly **9** includes a housing **90** and a liquid pump **95** arranged in the housing **90**. In this way, the housing **90** defines a cavity **94** having a liquid reserving function, so that the cavity **94** and liquid pump **95** are used as one modular structure without additionally arranging a separate reservoir. After this arrangement, the liquid pump cooling assembly **9** is small in volume and compact in structure, and the arrangement may further reduce the refrigerant charge in the refrigeration system, so as to achieve functions of reducing energy consumption and costs; and at the same time, since the above-mentioned liquid pump cooling assembly **9** is provided therein with one inlet and two outlets (i.e. the first outlet **91** and the second outlet **92**), the two outlets may send the refrigerant to different pipelines, and the refrigeration system is able to have the direct expansion refrigeration mode and the refrigerant pumping energy-efficiency mode, so as to achieve a function of integrating the two refrigeration modes on the same cooling circuit **100**; in addition, by means of the control assembly **22** that connects with the compressor **1** and the liquid pump **95**, switching between the above-mentioned two refrigeration modes may further achieved based on demand.

In some embodiments, the liquid pump **95** is a vertical-type centrifugal pump.

In others, the liquid pump **95** is a fluorine pump.

As shown in FIG. **2**, in the present disclosure, in a vertical direction, a height dimension of the first outlet **91** is smaller than a height dimension of the second outlet **92**, and the refrigerant inlet **93** is located between the first and second outlets **91**, **92**, the liquid pump **95** is located below the cavity **94**, and an interior chamber of the liquid pump **95** is connected with the cavity **94**.

Since the liquid pump cooling assembly **9** has the first outlet **91** and the second outlet **92**, so that a flow path of refrigerant in the refrigeration system in different modes is determined. The liquid pump **95** includes a pump shell, and an impeller **99** and an electric motor in the pump shell, the pump shell defines an interior chamber of the liquid pump **95**, and the pump shell is further provided with an inner inlet **96** communicating with the cavity **94** and an inner outlet **97** communicating to the second outlet **92**, both the inner inlet **96** and the inner outlet **97** are in communication with the interior chamber of the liquid pump **95**.

With the above-described arrangement, in the refrigerant pumping energy-efficiency mode, the liquid pump **95** can pump the refrigerant flowing into the liquid pump cooling assembly **9** to the cooling circuit **100**.

In the above-mentioned technical solution, the liquid pump **95** is arranged below the cavity **94**, such an arrangement reserves sufficient liquid reserving space; in the vertical direction of the liquid pump cooling assembly **9**, the second outlet **92**, the refrigerant inlet **93** and the first outlet **91** are sequentially arranged from top to bottom, in this way, after flowing from the refrigerant inlet **93**, the refrigerant can move downward under the influence of gravity and fills the interior chamber of the liquid pump **95**; in the refrigerant pumping energy-efficiency mode, the liquid refrigerant located in the interior chamber of the liquid pump **95** is pumped by the liquid pump **95** to flow out of the inner inlet **97** to the second outlet **92** and flows into the cooling circuit **100**; in the direct expansion refrigeration mode, the liquid pump **95** is in the closed state, the refrigerant flowing into the liquid pump cooling assembly **9** passes through the cavity **94** and directly flows out from the first outlet **91** at a bottom of the liquid pump cooling assembly **9**.

Since the usage amounts of the coolant needed in the direct expansion refrigeration mode and the refrigerant pumping energy-efficiency mode are different, the cavity **94** is employed to adjust the usage amounts of the coolant in two modes. Specifically, the liquid pump cooling assembly **9** is the cavity **94** having a liquid reserving function and the liquid pump **95** from top to bottom, respectively. The liquid pump **95** includes the electric motor and the impeller **99**. The liquid pump **95** is provided with the inner inlet **96** and the two inner outlets **97** for the impeller **99** to drive the refrigerant to be discharged, the two inner outlets **97** connect with the second outlet **92** through an outlet pipe **98**. After the refrigerant enters the liquid pump cooling assembly **9** from the refrigerant inlet **93**, it will fill a lower portion due to gravity, a lower part of the housing **90** is provided with the first outlet **91**, and the liquid pump **95** is provided with the inner inlet **96** through which the refrigerant enters the cavity of the impeller **99** of the liquid pump **95**. Therefore, the cavity **94** may adjust the usage amounts of the coolant in two operation modes, meanwhile when the refrigerant pumping energy-efficiency mode operates, the coolant liquid fills up the cavity **94** allowing the impeller **99** of the liquid pump **95** to be always filled up with liquid, in this way, the operation reliability and stability of the liquid pump **95** is ensured, since once the gaseous refrigerant occurs in the cavity of the impeller **99**, the liquid pump **95** will lose its effect, and the liquid pump **95** operating in a no-load operation will increase the temperature of the electric motor, and its prolonged operation will cause an electric motor failure; if cavitation occurs, the impeller **99** of the liquid pump **95** will be damaged too early.

As shown in FIG. **1** and FIG. **2**, in some examples of the present disclosure, the refrigeration system further includes a first pipeline **200** and a first one-way valve **10**. A first end of the first pipeline **200** is in communication with the second outlet **92**, and a second end of the first pipeline **200** is in communication with the inlet of the evaporator assembly **14**; the first one-way valve **10** is arranged on the cooling circuit **100**, and located between the refrigerant inlet **93** and a connecting node B of the first pipeline **200** and the cooling circuit **100**, the first one-way valve **10** is configured to prevent the refrigerant from flowing back to the refrigerant inlet **93**, when the refrigeration system is in the refrigerant pumping energy-efficiency mode, the refrigerant flowing out from the outlet of the condenser assembly **6** flows into the evaporator assembly **14** through the first pipeline **100**.

With the above-mentioned arrangement, the first pipeline **200** may achieve the function of integrating the two refrigeration modes on the same circulation circuit; when the refrigeration system is in the refrigerant pumping energy-efficiency mode, the first one-way valve **10** prevents the refrigerant flowing out from the second outlet **92** of the liquid pump cooling assembly **9** from flowing back to the first outlet **91** by a pipeline where the first one-way valve **10** is located, so that the refrigerant is prevented from flowing to the liquid pump cooling assembly **9**, which results in interruption of the whole refrigeration circulation, thereby ensuring the refrigerant in the cooling circuit **100** to flow orderly, and thus achieving the best cooling effect.

In the above-mentioned technical solution, by arranging the first pipeline **200**, the refrigerant can directly flow into the evaporator assembly **14** through the first pipeline **200** from the outlet of the condenser assembly **6**, and at this moment, the refrigeration system is in the direct expansion refrigeration mode; the first one-way valve **10** can only allow the refrigerant to flow toward the inlet of the evaporator assembly **14** from the first outlet **91** of the liquid pump cooling assembly **9**, which prevents the refrigerant from flowing in a reverse direction.

As shown in FIG. **1**, in some embodiments of the present disclosure, the refrigeration system further includes a second pipeline **300** and a second one-way valve **3**. The second pipeline **300** is arranged in parallel with the compressor **1**, the first end of the second pipeline **300** is connected to the outlet of the evaporator assembly **14**, the second end of the second pipeline **300** is connected with the inlet of the condenser assembly **6**; and the second one-way valve **3** is located on the second pipeline **300**.

With the above-mentioned arrangement, by arranging the second pipeline **300**, the refrigerant flowing out from the outlet of the evaporator assembly **14** may not pass through the compressor **1** but directly flow into the condenser assembly **6** through the second pipeline **300**. In this way, the second pipeline **300** arranged in parallel with the compressor **1** is employed to ensure the refrigerant has different flow paths in the cooling circuit **100**, so as to achieve that the refrigerant flows into the cooling circuit **100** after being compressed by the compressor **1** and the refrigerant bypasses the compressor **1** and flows into the cooling circuit **100** from the second pipeline **300**, so that the refrigeration system has the direct expansion refrigeration mode and the refrigerant pumping energy-efficiency mode, and thus the function of integrating the two refrigeration modes on the same circulation circuit is achieved; in addition, when the refrigeration system is in the refrigerant pumping energy-efficiency mode, the second one-way valve **3** may prevent the refrigerant from flowing back to the evaporator assembly **14** from the condenser assembly **6**, thereby ensuring the natural cooling and refrigeration to be performed effectively in the refrigerant pumping energy-efficiency mode.

As shown in FIG. **1**, in some embodiments of the present disclosure, the refrigeration system further includes a solenoid valve **2** arranged on the cooling circuit **100** and located between a connecting node A of the second pipeline **300** and the cooling circuit **100**, and the inlet of the compressor **1**.

With the above-mentioned arrangement, controlling the opening and closing of the solenoid valve **2** may ensure the refrigerant to flow based on correct paths in different modes, to avoid affecting normal operation of refrigeration circulation, thereby achieving the best refrigeration effect; and at the same time, the refrigeration system may further achieve switching between two modes based on actual demand.

In the above-mentioned technical solution, when the refrigeration system is in the direct expansion refrigeration mode, the control assembly **22** controls the solenoid valve **2** to be in the open state, so as to ensure that the refrigerant flowing out from the outlet of the evaporator assembly **14** can be totally sucked into the compressor **1** and cannot flow into the second pipeline **300**; when the refrigeration system is in the refrigerant pumping energy-efficiency mode, the control assembly **22** controls the solenoid valve **2** to be in the closed state, so as to ensure that the refrigerant flowing out from the outlet of the evaporator assembly **14** can totally and directly flow into the condenser assembly **16** through the second pipeline **300**, and cannot be sucked into the compressor **1**.

As shown in FIG. **1**, in the present disclosure, the refrigeration system further includes a third one-way valve **4** arranged on the cooling circuit **100** and located between the connecting node B of the second pipeline **300** and the cooling circuit **100**, and the outlet of the compressor **1**.

With the above-mentioned arrangement, the third one-way valve **4** may prevent the refrigerant flowing back to the outlet of the compressor **1** through the second pipeline **300**, to ensure the natural cooling and refrigeration to be performed effectively in the refrigerant pumping energy-efficiency mode.

As shown in FIG. **1** to FIG. **3**, in some embodiments of the present disclosure, the condenser assembly **6** includes a condenser body **17**, a gas header **18**, and a liquid header **19**. The condenser body **17** has a condensing inlet and a condensing outlet; the gas header **18** is in communication with the condensing inlet, and the gas header **18** is connected to the outlet of the compressor **1**; the liquid header **19** is connected with the condensing outlet, and the liquid header **19** is connected with the refrigerant inlet **93**; a pipe diameter of the liquid header **19** is greater than a pipe diameter of the gas header **18**.

With the above-mentioned arrangement, since the pipe diameter of the liquid header **19** is large, thus the liquid header **19** has a certain liquid reserving function, in a case where both the liquid header **19** and the cavity **94** of the liquid pump cooling assembly **9** have the liquid reserving function, a coolant capacity of the refrigeration system may be added to effectively balance the amount of coolant in another operation mode; in addition, the refrigeration system may not need to additionally arrange a separate reservoir, which may reduce the refrigerant charge in the refrigeration system, so as to achieve functions of reducing energy consumption and costs.

In the above-mentioned technical solution, the refrigerant gas flowing out from the outlet of the compressor **1** flows into the condensing inlet through the cooling circuit **100** and enters into the gas header **18** from the condensing inlet, the gaseous refrigerant may be condensed into a refrigerant liquid in the condenser assembly **6**, the condensed refrigerant liquid can be reserved in the liquid header **19** and be flowed out of the condenser assembly **6** from the condensing outlet. Since the liquid header **19** is connected to the refrigerant inlet **93**, the refrigerant liquid flowed out can be sent to the liquid pump cooling assembly **9**.

As shown in FIG. **1** to FIG. **3**, in the present disclosure, the condenser body **17** is of V-shaped, and the condenser assembly **6** further includes a condensing fan **7** arranged over the condenser body **17**, and the condenser assembly **6** includes a first branch pipe **20** and a second branch pipe **21**, the gas header **18** is connected with the outlet of the compressor **1** by the first branch pipe **20**, and the liquid header **19** is connected with the refrigerant inlet **93** by the second branch pipe **21**.

In the above-mentioned technical solution, the condensing fan **7** may speed up heat transfer effect of the refrigerant in the condenser body **17**; in addition, the gas header **18** of the condenser assembly **6** is connected with the outlet of the compressor **1** by the first branch pipe **20** and the second branch pipe **21**, the liquid header **19** is connected with the refrigerant inlet **93**, such an arrangement facilitates the flowing of the gas refrigerant that flows out of the compressor **1** to the condenser assembly **6**, and the flowing of the liquid refrigerant condensed and formed by the condenser assembly **6** to the liquid pump cooling assembly **9**.

As shown in FIG. **1**, in some embodiments of the present disclosure, the refrigeration system further includes an expansion valve **13** and a first temperature sensor **12**. The expansion valve **13** is arranged between the evaporator assembly **14** and the liquid pump cooling assembly **9**; along a flow direction of the refrigerant in the cooling circuit **100**, the first temperature sensor **12** is located at a position upstream of the expansion valve **13**, to detect the temperature of the refrigerant entering the evaporator assembly **14**.

With the above-mentioned arrangement, a function of performing real-time monitoring on the temperature of the refrigerant entering into the evaporator assembly **14** is achieved; in addition, arranging the expansion valve **13** may control the flow of the refrigerant entering into the evaporator assembly **14**, and at the same time causes a throttling and a pressure-reducing effect, so that the evaporator assembly **14** is protected from being damaged by the effect of the high-pressure, low-temperature, or superheated refrigerant.

In the above-mentioned technical solution, the first temperature sensor **12** is configured to detect the temperature of the refrigerant entering into the evaporator assembly **14** and to control the rotation speed of the condensing fan **7** according to the detected temperature; since the temperature of the refrigerant entering into the evaporator assembly **14** is below zero, frost will form on the evaporator assembly **14**, which will not only results in reduced refrigeration capacity but can have a negative impact on the refrigeration effect. In addition it can cause damage to an indoor fan if ice pieces drop down, therefore when the temperature detected by the first temperature sensor **12** is below zero, the rotation speed of the condensing fan **7** needs to be reduced, which reduces heat dissipation of the refrigerant in the condenser assembly **6**, so that the refrigerant whose temperature is below zero is prevented from entering into the evaporator assembly **14**, thereby ensuring a normal operation of the refrigeration system.

As shown in FIG. **1**, in the present disclosure, the refrigeration system further includes a second temperature sensor **5** and a third temperature sensor **16**. Both the second temperature sensor **5** and the third temperature sensor **16** are connected to the control assembly **22**. The control assembly **22** controls the opening and closing of the compressor **1** and the liquid pump **95** according to signals conveyed by the second temperature sensor **5** and the third temperature sensor **16**. The second temperature sensor **5** is located at a peripheral side of the condenser assembly **6** for monitoring outdoor temperature; the third temperature sensor **16** is located at a peripheral side of the evaporator assembly **14** for monitoring indoor temperature.

With the above-mentioned arrangement, according to the above-mentioned measured data, the control assembly **22** can control the refrigeration system in the different operation modes; and at the same time, such an arrangement may further monitor the environment of the refrigeration system in real time, so as to ensure the normal operation of the refrigeration system. Of course, according to practical situations, a temperature and humidity sensor may be used instead of the third temperature sensor **16**.

As shown in FIG. **1**, in the present disclosure, the refrigeration system further includes a first pressure sensor **8** and a second pressure sensor **11**.

In the above-mentioned technical solution, the first pressure sensor **8** which is located between the condenser assembly **6** and the refrigerant inlet **93** of the liquid pump cooling assembly **9** is configured to detect a pressure value of the refrigerant in the refrigerant inlet **93**; the second pressure sensor **11** is arranged on the cooling circuit **100** and located between the expansion valve **13** and a connecting node C of the cooling circuit **100** and the first pipeline **200**, and is configured to detect the pressure value of the refrigerant of the first outlet **91** or the second outlet **92**.

Monitoring a magnitude relationship between the pressure value of the second outlet **92** and the pressure value of the refrigerant inlet **93** may ensure the normal operation of the refrigeration system to achieve the best refrigeration effect.

The flow paths of the refrigerant in the two modes of the refrigeration system will be described below in combination with FIG. **1**.

When the outdoor temperature is high, the refrigeration system when it is in the direct expansion refrigeration mode, the compressor **1** is started, and the liquid pump cooling assembly **9** is not started. At this moment, the solenoid valve **2** of an air suction port of the compressor **1** is open, the compressor **1** sucks a low-pressure refrigerant gas and discharges a superheated high-pressure gaseous refrigerant; the gaseous refrigerant discharged from the compressor **1** dissipates heat in the condenser assembly **6** through the third one-way valve **4** and is condensed into a high-pressure saturated liquid coolant in the condenser assembly **6**; the liquid coolant flows into the refrigerant inlet **93** of the liquid pump cooling assembly **9** through the second branch pipe **21** of the condenser assembly **6**, since the refrigerant inlet **93** and the first outlet **91** in the liquid pump cooling assembly **9** are directly connected from inside, the coolant can directly flows out from the first outlet **91** of the liquid pump cooling assembly **9**; the coolant that flows out is changed to a low-temperature and low-pressure gas/liquid mixed refrigerant after passing through the first one-way valve **10** and being throttled by the expansion valve **13**; then the refrigerant is evaporated by absorbing heat through the evaporator assembly **14**, and takes heat from indoor environment; the coolant is changed to a low-temperature and low-pressure gaseous refrigerant after being evaporated by absorbing heat and returns to the compressor **1** through the solenoid valve **2**; in this way, the circulation of the direct expansion refrigeration mode is completed, and is repeatedly performed.

When the outdoor temperature is low, and the natural cooling demand is met, the refrigeration system is in the refrigerant pumping energy-efficiency mode, the compressor **1** stops operating, and the solenoid valve **2** of the air suction port of the compressor **1** is closed, the liquid pump cooling assembly **9** is activated to operate. The low-temperature and low-pressure liquid refrigerant flowing out from the condenser assembly **6** enters into the refrigerant inlet **93** of the liquid pump cooling assembly **9**, the impeller **99** of the liquid pump **95** rotates and sucks the saturated liquid refrigerant from the inner inlet **96**, which is compressed and reaches, through the inner outlet **97** and the interior outlet pipe, the second outlet **92** to flow out, the coolant that flows out is compressed by the liquid pump cooling assembly **9** and thus is changed from a saturated low-temperature liquid to a sub-cooled liquid. Since a portion of coolant passes through the electric motor over the impeller **99** of the liquid pump **95**, offsetting the heat generated by the electric motor, the normal operation of the electric motor is ensured. After the high-pressure coolant flows out from the second outlet **92** of the liquid pump cooling assembly **9**, since the pressure value of the second outlet **92** is higher than the pressure value of the refrigerant inlet **93**, the refrigerant will close the valve when it passes through the first one-way valve **10**, so as to prevent the coolant from flowing back; the coolant that flows out from the liquid pump cooling assembly **9** flows into the evaporator assembly **14** through the first temperature sensor **12** and the expansion valve **13**, and is evaporated by absorbing heat in the evaporator assembly **14** to be changed into the low-temperature and low-pressure gaseous coolant; since the solenoid valve **2** of the air suction port of the compressor **1** is closed, the gaseous coolant can bypass the compressor **1** and return to the condenser assembly **6** through the second one-way valve **3**, and then flow into the refrigerant inlet **93** of the liquid pump cooling assembly **9** from the condenser assembly **6**, so that the circulation of the refrigerant pumping energy-efficiency mode is completed, and is repeatedly performed. In a case where the refrigerant does not pass through the compressor **1**, the refrigerant is condensed in the condenser assembly **6** and is evaporated in the evaporator assembly **14**, which can make full use of outdoor natural cold sources to cool down the indoor equipment while the refrigerating energy consumption in low-temperature environment is greatly reduced.

As shown in FIG. **4** and FIG. **5**, some examples of this disclosure provide further information on how it controls the refrigeration system, which controls the above-mentioned refrigeration system through the control assembly **22**.

In the present disclosure, the control method includes the following steps.

An energy-efficiency refrigeration step that controls the refrigeration system while in a refrigerant pumping energy-efficiency mode of operation.

A compression refrigeration step that controls the refrigeration system in a direct expansion refrigeration mode is provided.

With the above-mentioned arrangement, the function of switching between the two refrigeration modes based on actual demand is achieved to control the refrigeration system to be at the different refrigeration steps. For example, the outdoor temperature is high in summer, the control of temperature in a machine room cannot be achieved by only relying on indoor and outdoor heat exchange, so the compressor **1** and the solenoid valve **2** need to be activated, and at this moment the refrigeration system may be controlled in a direct expansion refrigeration mode; when the outdoor temperature is low and can meet the natural cooling demand, the compressor **1** and the solenoid valve **2** are closed to save energy, the liquid pump **95** is opened and employed to achieve natural heat exchange of the refrigerant to control the refrigeration system to be in a refrigerant pumping energy-efficiency mode.

As shown in FIG. **3** and FIG. **5**, in the present disclosure, the condenser assembly **6** includes the condenser body **17** and the condensing fan **7** located at a side of the condenser body **17**. After the energy-efficiency refrigeration step, the control method further includes the following steps.

Determining the pressure value of the second outlet **92** and the pressure value of the refrigerant inlet **93**; A judgment step judges whether or not the pressure value of the second outlet **92** of the liquid pump cooling assembly **9** is greater than the pressure value of the refrigerant inlet **93**; if so, the step of adjusting the rotation speed of the condensing fan **7** or of the liquid pump **95** is executed; if not, an abnormality processing step is executed.

With the above-mentioned arrangement, monitoring a magnitude relationship between the pressure value of the second outlet **92** and the pressure value of the refrigerant inlet **93** and executing corresponding processing steps may ensure the normal operation of the refrigeration system to achieve the best refrigeration effect.

Specifically, when the pressure value of the second outlet **92** of the liquid pump cooling assembly **9** is greater than the pressure value of the refrigeration inlet **93**, it indicates that the liquid pump **95** operates normally, and at this moment, it is only necessary to adjust the rotation speed of the condensing fan **7** or of the liquid pump **95** according to the refrigeration demand; when the pressure value of the second outlet **92** of the liquid pump cooling assembly **9** minus the pressure value of the refrigerant inlet **93** is less than a deviation value, and at this moment, it indicates that abnormality occurs in the liquid pump **95**, it is necessary to execute the abnormality processing step (such as, re-start the liquid pump **95**, etc.), this may ensure the normal operation of the refrigeration system.

In the present disclosure, after the energy-efficiency refrigeration step, the control method further includes: a detection step of detecting the temperature of the refrigerant that enters into the evaporator assembly **14**; a temperature judgment step of judging whether or not the temperature of the refrigerant is below zero, if so, the step of adjusting the rotation speed of the condensing fan **7** of the condenser assembly **6** is executed; if not, the temperature judgment step is repeated.

With the above-mentioned arrangement, the refrigerant whose temperature is below zero is prevented from entering the evaporator assembly **14**, so as to avoid reducing in refrigeration capacity caused by evaporator **14** frosting and the fan damage that may be caused by the dropping of ice pieces, so that the normal operation of the refrigeration system is guaranteed while at the same time the refrigeration system having a stable refrigeration effect is ensured.

In the present disclosure, in the compression refrigeration step, the control method further includes the adjustment step of adjusting the rotation speed of the compressor **1**.

With the above-mentioned arrangement, adjusting the rotation speed of the compressor **1** can control the flow rate of the refrigerant in the cooling circuit **100** and at the same time can further adjust the temperature and pressure of the refrigerant flowing out of the compressor **1**, so that the normal operation of the refrigeration system is guaranteed to reach a better refrigeration effect.

From the above description, it may be seen that the above-mentioned embodiments of the present disclosure achieves the following technical effects.

The evaporator assembly is configured to evaporate the liquid refrigerant that flows in into the gaseous refrigerant, and the low-temperature and low-pressure refrigerant gas flows out; the condenser assembly may function to dissipate heat and to condense the gaseous refrigerant into the liquid refrigerant; the compressor is configured to condense the low-pressure refrigerant gas that flows in into the superheated high-pressure refrigerant gas, and the compressor can drive the refrigerant to circulate in the cooling circuit. The first pipeline and the second pipeline can send refrigerant when the refrigeration system is in the refrigerant pumping energy-efficiency mode. The first, second, and third one-way valves are able to control the flow direction of the refrigerant, thereby preventing the refrigerant in the pipeline from flowing back; the solenoid valve may control the opening and closing of the air suction port of the compressor **1**, so as to ensure that the flow direction of the refrigerant in the refrigeration system is normal; the expansion valve can control the flow of the refrigerant entering into the evaporator assembly, and the first temperature sensor may monitor and feed back the temperature of the refrigerant entering into the evaporator assembly, which may protect normal operation of the evaporator assembly; the second temperature sensor and the third temperature sensor may monitor the indoor and outdoor temperature and humidity of the environment where the refrigeration system is located, so that the control assembly controls the refrigeration system to be in different refrigeration modes. The cavity having the liquid reserving function and the liquid pump are used as one modular structure, consequently there is no need to additionally arrange a separate reservoir. After this arrangement, the liquid pump cooling assembly is small in volume and compact in structure, and the arrangement may further reduce the refrigerant charge in the refrigeration system, so as to achieve functions of reducing energy consumption and costs; and at the same time, since the above-mentioned liquid pump cooling assembly is provided therein with one inlet and two outlets (i.e. the first outlet and the second outlet), the two outlets is able to send the refrigerant to different pipelines, and the refrigeration system can have the direct expansion refrigeration mode and the refrigerant pumping energy-efficiency mode, so as to achieve a function of integrating two refrigeration modes on the same cooling circuit; in addition, switching between the above-mentioned two refrigeration modes is achieved based on demand by the control assembly that connects to the compressor and the liquid pump.

The above description is only some embodiments of the present disclosure, and is not intended to limit the present disclosure, and for those skilled in the art, the present disclosure may have various modifications and changes. Any modification, equivalent replacement, improvement, etc. made according to the spirit and principle of the present disclosure shall be regarded as within the protection scope of the disclosure.

What is claimed is:

1. A refrigeration system with a direct expansion refrigeration mode and a refrigerant pumping energy-efficiency mode comprising a cooling circuit including a compressor, an evaporator assembly, and a condenser assembly sequentially arranged on the cooling circuit, the refrigeration system further comprising:

- a liquid pump cooling assembly arranged on the cooling circuit and located between the condenser assembly and the evaporator assembly, wherein the liquid pump cooling assembly comprises:
  - a housing and a liquid pump arranged in the housing, the housing defining a cavity that has a liquid reserving function;
  - a refrigerant inlet communicating with the cavity;
  - a first outlet connected to the cavity; and
  - a second outlet connected to the liquid pump;
  - wherein an outlet of the condenser assembly is connected with the refrigerant inlet, and both the first outlet and second outlet are connected with an inlet of the evaporator assembly; and
  - a control assembly, wherein the compressor and the liquid pump are respectively connected with the control assembly to enable the refrigeration system to have a direct expansion refrigeration mode and a refrigerant pumping energy-efficiency mode;
  - wherein in the direct expansion refrigeration mode the compressor is in an open state and compresses refrigerant that is in a vapor phase and the liquid pump is in a closed state, such that refrigerant flowing out from the outlet of the condenser assembly enters into the evaporator assembly after sequentially passing through the refrigerant inlet and the first outlet so as to enable refrigerant to circulate in the cooling circuit by the compressor; and
  - in the refrigerant pumping energy-efficiency mode the liquid pump is in an open state and pumps refrigerant in a liquid state and the compressor is in a closed state, such that under an effect of the liquid pump, refrigerant flowing out from the outlet of the condenser assembly flows out from the second outlet and enters the evaporator assembly.

2. The refrigeration system with the direct expansion refrigeration mode and the refrigerant pumping energy-efficiency mode of claim **1**, further comprising:

a first pipeline, wherein an end of the first pipeline is connected with the second outlet and an other end of the first pipeline is connected with the inlet of the evaporator assembly; and

a first one-way valve positioned on the cooling circuit, and located between the refrigerant inlet and a connecting node of the first pipeline and the cooling circuit, wherein the first one-way valve is configured to prevent refrigerant from flowing back to the refrigerant inlet when the refrigeration system is in the refrigerant pumping energy-efficiency mode, such that refrigerant flowing out from the outlet of the condenser assembly flows into the evaporator assembly through the first pipeline.

3. The refrigeration system with the direct expansion refrigeration mode and the refrigerant pumping energy-efficiency mode of claim **1**, wherein in a vertical direction a height dimension of the first outlet is smaller than a height dimension of the second outlet, the refrigerant inlet is located between the first outlet and the second outlet, and the liquid pump is located below the cavity such that an interior chamber of the liquid pump is in communication with the cavity.

4. The refrigeration system with the direct expansion refrigeration mode and the refrigerant pumping energy-efficiency mode of claim **1**, further comprising:

a second pipeline, arranged in parallel with the compressor, wherein a first end of the second pipeline is connected to an outlet of the evaporator assembly, and a second end of the second pipeline is connected with an inlet of the condenser assembly; and

a second one-way valve arranged on the second pipeline.

5. The refrigeration system with the direct expansion refrigeration mode and the refrigerant pumping energy-efficiency mode of claim **4**, further comprising a solenoid valve arranged on the cooling circuit, wherein the solenoid valve is located between an inlet of the compressor and a connecting node of the second pipeline and the cooling circuit.

6. The refrigeration system with the direct expansion refrigeration mode and the refrigerant pumping energy-efficiency mode of claim **1**, wherein the condenser assembly comprises:

a condenser body having a condensing inlet and a condensing outlet;

a gas header communicating with the condensing inlet, wherein the gas header is connected to an outlet of the compressor; and

a liquid header communicating with the condensing outlet and connected with the refrigerant inlet, wherein a pipe diameter of the liquid header is greater than a pipe diameter of the gas header.

7. The refrigeration system with the direct expansion refrigeration mode and the refrigerant pumping energy-efficiency mode of claim **6**, wherein the condenser body is V-shaped, and the condenser assembly further comprises:

a condensing fan arranged over the condenser body;

a first branch pipe; and

a second branch pipe;

wherein the gas header is connected with the outlet of the compressor through the first branch pipe, and the liquid header is connected with the refrigerant inlet through the second branch pipe.

8. The refrigeration system with the direct expansion refrigeration mode and the refrigerant pumping energy-efficiency mode of claim **1**, further comprising:

an expansion valve arranged between the evaporator assembly and the liquid pump cooling assembly; and

a first temperature sensor located at an upstream position of the expansion valve along a flow direction of refrigerant in the cooling circuit to detect a temperature of refrigerant entering into the evaporator assembly.

9. A control method of the refrigeration system of claim **1**, the control method comprising:

an energy-efficiency refrigeration step of controlling the refrigeration system to be in a refrigerant pumping energy-efficiency mode; and

a compression refrigeration step of controlling the refrigeration system to be in a direct expansion refrigeration mode.

10. The control method of claim **9**, wherein the condenser assembly comprises a condenser body and a condensing fan located at a side of the condenser body, and after the energy-efficiency refrigeration step the control method further comprises:

a determining step of determining a pressure value of the second outlet and a pressure value of the refrigeration inlet; and

a pressure value judgment step of judging whether or not the pressure value of the second outlet of the liquid pump cooling assembly is greater than the pressure value of the refrigerant inlet; wherein—

when it is judged that the pressure value of the second outlet is greater than the pressure value of the refrigerant inlet, a step of adjusting a rotation speed of the condensing fan or the liquid pump is executed; and

when it is judged that the pressure value of the second outlet is not greater than the pressure value of the refrigerant inlet, an abnormality processing step is executed.

11. The control method of claim **9**, wherein after the energy-efficiency refrigeration step, the control method further comprises:

a detection step of detecting a temperature of refrigerant that enters into the evaporator assembly; and

a temperature judgment step of judging whether or not the temperature of refrigerant is below zero; wherein

when it is judged that the temperature of refrigerant is below zero, a step of adjusting a rotation speed of the condensing fan of the condenser assembly is executed; and

when it is judged that the temperature of refrigerant is not below zero, the temperature judgment step is repeatedly executed.

12. The control method of claim **9**, wherein the compression refrigeration step further comprises an adjustment step of adjusting a rotation speed of the compressor.

13. The control method of claim **9**, wherein the refrigeration system further comprises:

a first pipeline, wherein an end of the firstpipe line is connected with the second outlet and an other end of the first pipeline is connected with the inlet of the evaporator assembly; and

a first one-way valve positioned on the cooling circuit and located between the refrigerant inlet and a connecting node of the first pipeline and the cooling circuit, wherein the first one-way valve is configured to prevent refrigerant from flowing back to the refrigerant inlet when the refrigeration system is in the refrigerant pumping energy-efficiency mode, such that refrigerant flowing out from the outlet of the condenser assembly flows into the evaporator assembly through the first pipeline.

14. The control method of claim **9**, wherein in a vertical direction a height dimension of the first outlet is smaller than a height dimension of the second outlet, the refrigerant inlet is located between the first outlet and the second outlet, and the liquid pump is located below the cavity such that an interior chamber of the liquid pump is in communication with the cavity.

15. The control method of claim **9**, wherein the refrigeration system further comprises:

a second pipeline, arranged in parallel with the compressor, wherein a first end of the second pipeline is connected to an outlet of the evaporator assembly, and a second end of the second pipeline is connected with an inlet of the condenser assembly; and

a second one-way valve arranged on the second pipeline.

16. The control method of claim **15**, wherein the refrigeration system further comprises a solenoid valve arranged on the cooling circuit, wherein the solenoid valve is located between an inlet of the compressor and a connecting node of the second pipeline and the cooling circuit.

17. The control method of claim **9**, wherein the condenser assembly comprises:

a condenser body having a condensing inlet and a condensing outlet;

a gas header communicating with the condensing inlet, wherein the gas header is connected to an outlet of the compressor; and

a liquid header communicating with the condensing outlet and connected with the refrigerant inlet, wherein a pipe diameter of the liquid header is greater than a pipe diameter of the gas header.

18. The control method of claim **17**, wherein the condenser body is V-shaped, and the condenser assembly further comprises:

a condensing fan arranged over the condenser body;

a first branch pipe; and

a second branch pipe, wherein the gas header is connected with the outlet of the compressor through the first branch pipe, and the liquid header is connected with the refrigerant inlet through the second branch pipe.

19. The control method of claim **9**, wherein the refrigeration system further comprises:

an expansion valve arranged between the evaporator assembly and the liquid pump cooling assembly; and

a first temperature sensor located at an upstream position of the expansion valve along a flow direction of refrigerant in the cooling circuit to detect a temperature of refrigerant entering the evaporator assembly.

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